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REVIEW ARTICLE

Pavetta indica as an Emerging Reservoir of Bioactive Compounds with Promising Therapeutic Potential

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Abstract

Pavetta indica belongs to the family Rubiaceae and is a tropical shrub broadly distributed throughout the Indian subcontinent and Southeast Asia. It has rich traditional medical uses and, therefore, represents an important source of research interest because of its extensive array of bioactive compounds as well as their potential for therapeutic properties. This plant has proven to be one of the richest sources of natural products, which include alkaloids, flavonoids, saponins, tannins, and phenolic compounds that have been researched for various pharmacological effects, including antioxidant, anti-inflammatory, antimicrobial activities, anticancer properties, and its potential for hepatoprotective action, making *P. indica* a valuable candidate drug for research and development for therapeutics. The parts of the plant were used by traditional medicine in the treatment of such conditions as fever, pain, gastrointestinal disorders, and some infections on the skin. Most of the claims on this plant are recently made true with significant biological activity in *P. indica* towards modern therapeutic uses. Most of the bioactive compounds in this plant interact with several targets at the molecular level, helping explain mechanisms underlying medicinal applications. Although the pharmacological profile appears promising, the compound must be further explored through clinical studies to validate efficacy and safety for human application.

Key words: Anticancer potential, flavonoids, *Pavetta indica*, rubiaceae

INTRODUCTION

Pavetta indica belongs to the Rubiaceae family and is a small shrub but natively found within the Indian subcontinent, while its tropical distribution covers all tropical regions.[1-3] Because of its medicinal properties and for being one of the first compounds discovered to contain multiple bioactive compounds, it is considered of interest within natural product research.[4,5] These compounds have been widely reported to exhibit a number of pharmacological activities such as antioxidant, anti-inflammatory, antimicrobial, anticancer, and hepatoprotective effects.[6,7] This review article aims to address the potential of *P. indica* as a reservoir of promising therapeutic compounds.[8-10] The rich phytochemical profile of *P. indica* mainly includes alkaloids, flavonoids, glycosides, saponins, tannins, and phenolic compounds. As more and more parts of society began adopting traditional medicine, the scientific world found the urge to probe further for molecular mechanisms of the said activities to unravel its hidden value in the application in modern medicine.[11,12] *P. indica* Species falls under the category of family Rubiaceae. Within the past couple of years, much has been made of it in respect to bioactive compounds it yields with various pharmacological properties that could have potential medical implications.[13-15] Known as "Indian Pavetta" to commoners, it widely occurs across the tropical and subtropical regions of the world; more common places are the Indian subcontinent and Southeast Asia. The traditional use of the plant for centuries in the treatment of various diseases, starting from the digestion disorders and fever to general skin infections, was made by indigenous people. Such high scientific interest in *P. indica* has been

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recorded over its rich profile of phytochemicals that include several varieties of alkaloids, flavonoids, glycosides, tannins, saponins, and phenolic compounds. The therapeutic values as determined for this plant have been corroborated through a multitude of *in vitro* and *in vivo* experiments. *P. indica* has proved to have a wide range of pharmacological activities: From potent antioxidant, anti-inflammatory, antimicrobial, anticancer, and hepatoprotective effects, making it one of the emerging candidates for the field of natural medicine. Interest in herbal and alternative medicines, with increasing demand for novel therapeutic agents, has further encouraged researchers to investigate the pharmacological potential of plants like *P. indica*. With a wide scope of bioactive compounds, it is one of the attractive plant candidates for new drug or natural remedy development, especially if used in complementary treatments with Western medicine. Moreover, the ever-increasing tendency toward an eco-friendly therapeutic approach means that research on novel drug development from natural sources becomes of significant importance to the medical and pharmaceutical fraternity. While there is a significant amount of evidence to prove the therapeutic benefits of *P. indica*, most of such studies are preliminary and often conducted on animal models or *in vitro*. Therefore, there still remains a need for more clinical research to assess the full safety and efficacy of the plant in humans and decipher the mechanisms of action. Furthermore, and more importantly, recognizing the complex interactions of active compounds from the plant with their molecular targets will help in optimizing therapeutic use and better formulation and preparation in the future. In this review, *P. indica* is considered to be a promising source of therapeutic compounds based on its botanical description, distribution, traditional usage, and pharmacological activities. Using this approach, we will discuss its antioxidant and anti-inflammatory activities, antimicrobial and anticancer actions, as well as hepatoprotective effects and other activities, through mechanisms of action. We will also discuss safety and toxicological profiles and potential applications of the plant in modern medicine.[16,17] Finally, the review would be concluded by outlining directions of future research and potential further development of *P. indica* in clinical applications. Therefore, by bringing together various strands of current scientific evidence into synthesis, this review could prove to be of enormous value in establishing insights concerning the therapeutic potential of *P. indica* in terms of novel compounds with pharmacological relevance, representing an emerging source.[5,18,19]

BOTANICAL DESCRIPTION AND DISTRIBUTION

P. indica is a shrub or small, perennial tree with an average height of 1–3 m. Leaves are large, ovate in shape, and with very small, white, or pale pink tubular flowers borne in dense clusters. The fragrance of the flowers is strong and pleasant, attracting pollinators, whereas the fruit is a small, globose berry with seeds inside. It is spread throughout the tropical and subtropical regions, particularly in India, Sri Lanka, Bangladesh, and other Southeast Asian countries.

BOTANICAL DESCRIPTION

Leaves

P. indica has opposite, simple leaves, which are ovate to elliptical. It measures 5–10 cm in length and 2–5 cm in width. The margins are smooth or entire, while the upper surface is shiny or glossy. The lower surface of the leaf is a light green color, mostly having dark venation.

Flowers

The small, fragrant, white to pale pink flowers, arranged in dense terminal clusters, are found on the plant. Tubular flowers are fused at their base, and they have five petals, making them bell-like. These flowers are about 1–2 cm long with a sweet, pleasant fragrance. They attract various pollinators, including bees and butterflies. The flowering period is often in warm months, making the plant even ornamentally valuable.

Fruits

The fruit of *P. indica* is small, berry, round, and fleshy, about 1–2 cm in diameter, initially green, later darker, black, or dark purple-colored. The fruit has more seeds and is a dispersed mechanism in the plant and dispersal for the plant in various different habitats.

Stem and bark

P. indica has a woody stem that is smooth or roughly coriaceous. Brown and greyish-brownish color of the bark in relative thinness as that with regard to other tree species is typically expected. Fine hairs coat much of the plant's younger stems and older ones and contribute to the plant looking partly fuzzy or soft.

Habitat and distribution

P. indica is originally from the tropical and subtropical regions of the Indian subcontinent and Southeast Asia. It grows best under conditions of high humidity and frequent rainfall. It can often be found in the forests, riverbanks, or moist, well-drained soils. It occurs mainly in tropical forests' undergrowth or semi-shaded parts, where filtered sunlight favors it India: *P. indica* is very widespread in India. They are mainly found in Kerala, Tamil Nadu, Karnataka, and Andhra Pradesh.[20,21] This species is also abundant in the Western Ghats, a hotspot for biodiversity in southern India,



Figure 1: Whole plant of *Pavetta indica*

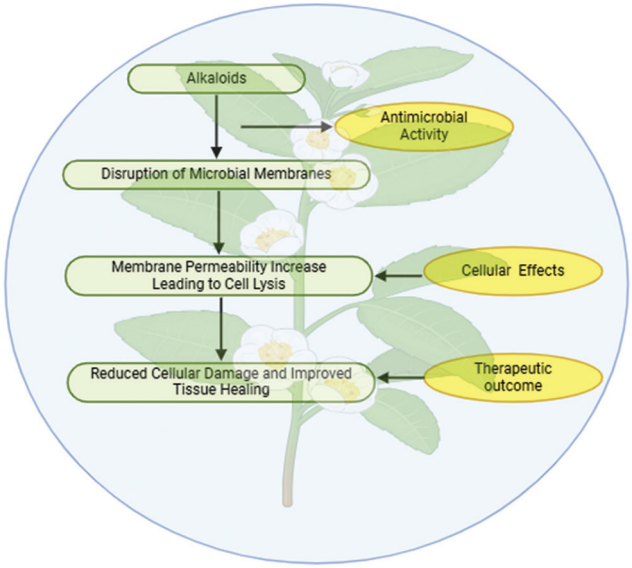


Figure 2: Mechanism of action showing antimicrobial activity of *Pavetta indica*

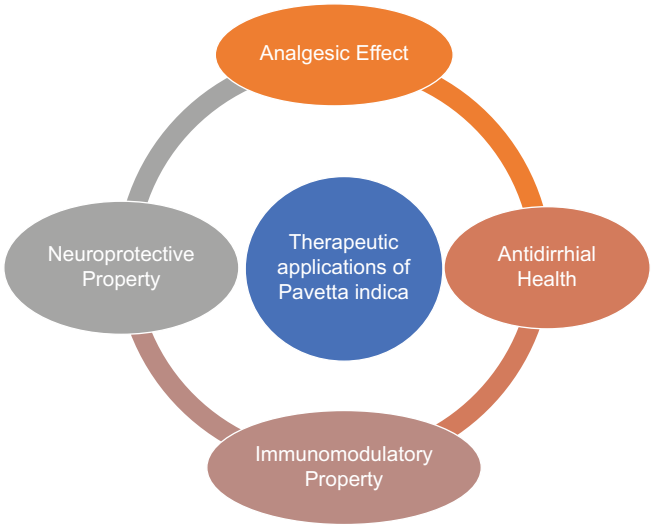


Figure 3: Therapeutic applications of *Pavetta indica*

which enjoys high humidity in its mountainous regions. Sri Lanka: It is widespread in Sri Lanka, especially in lowland and montane forests. The plant grows at various altitudes. It is widely grown in home gardens and used for local medicinal purposes. Bangladesh and Myanmar: The plant grows in subtropical forests and wetlands areas of Bangladesh, which it especially prefers to grow, as the banks of rivers and mangrove forests offer favorable conditions.[22] In Myanmar, *P. indica* has been considered native to the country's tropical rainforests and moist hilly regions. South Asia: The plant occurs elsewhere in Southeast Asia in Thailand, Malaysia, and Indonesia, for example, in several areas of relatively wet habitats throughout these regions and with their general adaptations. The whole plant of Pavetta indica given in fig 1.

Traditional uses of *P. indica*

It is utilized in several disorders based on traditional practice. Among various folk remedies and systems of Ayurvedic drugs, *P. indica* finds frequent application with the help of its suppositional medicinal properties. The majority of the established traditional application uses include: Fever: Infusion of the leaves is used as a treatment for fever and its associated symptoms. Gastrointestinal disorder: The plant is used to treat antidiarrheal and digestive disorders. Pain relieving: *P. indica* is administered for treating pain and inflammation, especially in cases like arthritis.[23] Wound healing: The leaves are applied topically to help heal wounds and decrease inflammation. Skin infection: The plant is assumed to have antifungal and antibacterial elements, which are helpful for the treatment of skin-related infections.[24] The mechanism of action for antimicrobial activity of plant displayed in fig 2.

Phytochemical properties of *P. indica*

Alkaloids: Several alkaloids have been found in leaves and flowers that give this plant medicinal properties. Flavonoids: *P. indica* contains the flavonoids quercetin and kaempferol, each of which is an excellent antioxidant and anti-inflammatory agent.[25] Glycosides: The plant contains different types of glycosidic compounds, which are found to have many therapeutic effects. Saponins: These compounds have been linked to a broad spectrum of biological activities, such as anti-inflammatory and antimicrobial effects. Tanins and phenolic compounds: These compounds possess the properties of being antioxidant, antimicrobial, and anti-inflammatories.[26,27]

Pharmacological activities

P. indica has shown an entire range of pharmacological activity, most scientifically proven by the results of *in vitro* and *in vivo* studies. These most significant pharmacological activities are: Antioxidant activity: Antioxidant activity

Table 1: Advantages and disadvantages of *Pavetta indica*

Advantages	Disadvantages
Traditional application is to treat several health problems, including fever and inflammation, and in cases of digestive disorders[34]	Some parts of the plant can be toxic if consumed in huge quantities or otherwise prepared badly[39]
Shows anti-inflammatory action useful to minimize the pain and edema[35,36]	Scientific studies on its efficacy and safety are scarce
Has the substance to help reduce oxidative stress with free radicals in the system[37]	It can become invasive in some regions and may impact local ecosystems[40]
The compound improves digestible health; it has some mild laxative effects as well.	Limited commercial cultivation; it is therefore difficult to source from some regions.
It possesses a small quantity of antibacterial compounds. It can help solve infectious diseases[38]	The plant can cause allergic reactions in some people.[41]

is one of the widely studied properties of *P. indica*.[14] The various therapeutic application of the plant displayed in fig 3. Extracts from this plant have been demonstrated to contain a very significant free radical scavenging activity. These antioxidant properties were attributed to polyphenols, flavonoids, and tannins, which modulated oxidative stress to counter oxidative damage related to aging, chronic diseases, and cancer.[28] The advantage and disadvantage of Pavetta indica given in table 1.

Anti-inflammatory activity

Several studies have reported the efficacy of *P. indica* as having an excellent anti-inflammatory property; thereby, it is beneficial to inhibit diseases such as arthritis, asthma, and other inflammatory ailments. The anti-inflammatory activities primarily arise from the plant content of flavonoids and its ability to suppress cyclooxygenase-2-producing proinflammatory cytokines and enzymes.

Antimicrobial activities

The antimicrobial activity of *P. indica* has been thoroughly investigated. Various studies established that the plant is significantly active against bacteria, fungi, and viruses.[8] The ability to inhibit different types of pathogens, such as *Staphylococcus aureus*, *Escherichia coli*, *Candida albicans*, and Herpes simplex virus, makes this plant a natural source of antimicrobial agents.

Anticancer potential

The anticancer potential of *P. indica* has been reported in several studies. The plant extracts have been found to have potential cytotoxic activity against various cancer cell lines: Breast, liver, lung, etc. This anticancer activity is thought to be expressed through the modulation of apoptosis and inhibition of proliferation in the cancer cells.[29]

Hepatoprotective activity

P. indica possesses a hepatoprotective profile both in animal and cellular models.[30] It may limit toxin-induced liver damage of alcohol and paracetamol through its antioxidant activity along with the anti-inflammatory ability for maintenance of functional capability of the liver besides inhibition of oxidative stress-induced liver injury.

Other therapeutic activities

Antidibetic effect: Several studies indicate that this plant controls blood glucose levels and can potentially manage diabetic conditions. Antiobesity effect: Preclinical studies have indicated that it modulates lipid metabolism and reduces body weight. Neuroprotective activity: *P. indica* has been reported to exhibit neuroprotective activity and hence holds promise in the management of neurodegenerative diseases like Alzheimer's disease.[31]

Mechanism of action

Antimicrobial activity: Bacterial cell membrane disruption. Interference with microbial enzymes and inhibition of microbial growth. Antioxidant activity: Scavenging reactive oxygen species (ROS) to prevent the reaction of free radicals. Anti-inflammatory activity: It inhibits free radicals by scavenging ROS.[32] Cancer cell apoptosis: The involvement of caspases in the induction of apoptosis in cancerous cells along with alteration of Bcl-2 family proteins.[33]

Safety and toxicological evaluations

Natural products' therapeutic potential might depend upon safety and toxicity assessments. Numerous studies have evaluated the acute and chronic toxicity of *P. indica* in animal models. Thus, this plant appears to have relatively low toxicity, as no adverse effect is reported at therapeutic dosages. However, a detailed toxicological study, as well as long-term safety assessments, are required to be developed to determine safe usage for human consumption. Though *P. indica* is promising in medicinal applications, it also poses a risk factor for its safety. Traditional use has often relied on empirical knowledge regarding the correct dosages and

Table 2: Possible applications and future directions

Area	Applications	Details
Clinical trials	Human clinical trials	Conduct a trial to determine if *Pavetta indica* is safe and effective in a particular disease management process.
Phytochemical isolations	Isolation and characterization	Isolation and characterization of single bioactive compound of pharmacological activities of the plant.
Formulation development	Novel drug formulations	Novel formulations for drugs such as extracts, phytosomes, or nanoparticles for improved bioavailability and targeted delivery.
Renewable energy	Sustainable production	Investigating ways for sustainable production and harvesting of this precious and dwindling resource.
Pharmacological development	Potential cancer therapy	Its potential use in adjunct therapy with cancer may be preclinically tested for its efficacy or not.
	Anti-inflammatory agents	Prepare topical preparations for anti-inflammatory conditions, for instance, dermatitis and arthritis.
	Antiviral agents	Assessment of their effectiveness against emerging viral infections, such as influenza or SARS-CoV-2.
Dermatology and cosmetic science	Skin herbal creams	Mild cuts and abrasions, dermatitis, pimples.
	Antiaging products	Protecting the skin from oxidative damage through their antioxidative properties.
	Sunscreen agents	This is an active ingredient of sunscreens because it could block ultraviolet rays.
Development of nutraceuticals	Health-promoting teas/ energizing drinks	Designs teas and drinks using *Pavetta Indica* extract for nutritional benefits.
	Fortified foods	Fortify grains or edible oils to enhance health effects
Agriculture and biopesticides	Natural insecticides	Develop eco-friendly pest control solutions using *Pavetta indica* extracts.
	Soil health enhancers	Explore its role as a soil enhancer from a microbial perspective to improve soil health.

preparations of the plant. However, limited scientific data is available for its toxicology and long-term safety. Preliminary studies have indicated potential gastrointestinal disturbances, allergic reactions, and other toxic effects from consuming excessive amounts of some parts of the plant. For safe consumption, further studies should be performed to evaluate the toxicity profile of the plant, safe dosages, and prolonged effects. This will determine whether *P. indica* should be widely recommended for therapeutic uses.

Possible applications and future directions

There is a vast application and future scope in the usage of *P. indica*, a plant with wide usage in herbal medication, owing to its bioactive constituents, historical applications, and promise for contemporary advantages in therapy, agriculture, and ecological perspectives. As Shown in Table 2.

CONCLUSION

The intriguing species of plant, *P. indica*, is related to bioactive chemical content, providing it with hundreds of therapeutic capabilities. It can supply innovative methods to deal with essential pressing health problems, the medicine of this day and time has due to its very complex constitution consisting alkaloids, flavonoids, tannins, and saponins. Collectively, these have bestowed on *P. indica* the qualities of being hepatoprotective, anti-inflammatory, antioxidant, antibacterial, and antidiabetic. As looking for medications of alternative therapies for chronic diseases is vital at this hour to limit contemporary medicine-induced risks associated to health, this study will also complete the jigsaw piece. However, a sophisticated phytochemical characterization that comprises preclinical investigations paired with rigorous clinical trials will enable the safe and proper application of traditional use for therapeutic purposes. Success in the issues described here enables the risk-free application without dangers involved in the clinical and therapeutic contexts. In addition, standardization of extraction procedures, clarity of dose parameters, and the exploration of potential synergistic effects with other medicinal flora could improve its efficacy.

Since *P. indica* represents a component of the major global health concerns, its integration with traditional knowledge in contemporary scientific approaches has the potential to revolutionize the pharmaceutical landscape of the world.

With a highly considerable bioactive potential, *P. indica* is crucial in research on novel means of medicine. It is a plant that is not only endowed with antibacterial, antioxidant,

and anti-inflammatory characteristics but also anticancer properties and many other phytochemicals for it to be put out into contemporary society to serve to answer big health-related problems. Its applications span medical disciplines and sustainable agriculture, cosmetics, and nutraceuticals. This might happen only when *P. indica* becomes the hub for multi-disciplinary research and collaborative studies. Then, the pharmacological action of *P. indica* may become clearer, and its prospective applications may be achieved when contemporary scientific technique merges with traditional knowledge systems. Advances in biotechnology, notably by the methods of synthetic biology and genom research, might be utilized to help generate bioactive substances from this species in huge quantities, which would open more possibilities in the advancement of novel pharmaceuticals as well as sustainable manufacture. *P. indica*, combining established traditional practices with innovative modern practices, therefore holds the possibility of upgrading from a traditional remedy to a key part of modern therapeutic approaches and industrial applications geared to resolve worldwide health and sustainability issues. Indeed, the history of a little-known plant now being turned into a rainbow of bioactive compounds has great possibilities for agriculture, medicine, and much more in the years to come.

REFERENCES

1. Darwin SP. A synopsis of the indigenous genera of pacific Rubiaceae. Allertonia 1979;2:1-44.
2. Asahara V, Perera A, Jalini P, Hansani I, Ranasinghe K, Marasinghe P. Phytochemical and potential pharmacological properties of *Pavetta indica* Linn. Eur J Med Plants 2021;32:1-11.
3. Raju AJ, Rao MM. Flowering phenology, breeding system, pollinators and fruiting behaviour of *Pavetta tomentosa* (Rubiaceae) Roxb. Ex Sm., a keystone shrub species in the southern eastern ghats forest, Andhra Pradesh, India. Ann Bot 2016;6:85-96.
4. Gobalakrishnan R, Bhuvaneswari R. Natural bioactive compounds and antimicrobial potential of *Pavetta indica* L. J Anal Pharm Res 2021;10:161-4.
5. Attah AF, Fagbemi AA, Olubiyi O, Dada-Adegbola H, Oluwadotun A, Elujoba A, *et al*. Therapeutic potentials of antiviral plants used in traditional African medicine with COVID-19 in focus: A Nigerian perspective. Front Pharmacol 2021;12:596855.
6. Bourais I, Elmarrkechy S, Taha D, Mourabit Y, Bouyahya A, El Yadini M, *et al*. A review on medicinal uses, nutritional value, and antimicrobial, antioxidant, anti-inflammatory, antidiabetic, and anticancer potential related to bioactive compounds of J. regia. Food Rev Int 2023;39:6199-249.
7. Abima Shazhni JR, Renu A, Vijayaraghavan P. Insights of antidiabetic, anti-inflammatory and hepatoprotective properties of antimicrobial secondary metabolites of corm extract from *Caladium x hortulanum*. Saudi J Biol Sci 2018;25:1755-61.
8. Akhtar N, Husen A, Dwibedi V, Rath SK, editors. Promising Antiviral Herbal and Medicinal Plants. United States: CRC Press; 2024.
9. Razão EH, Sánchez M, Naval MV, Gavilán RG, Gómez-Serranillos MP. Biodiversity, traditional uses, and pharmacological potential of medicinal plants of Mozambique. Agriculture 2024;14:2204.
10. Sharma R, Saxena R, Nandy BC. Extraction of bioactive chemical compounds and antibacterial activity of biowaste fruit peels extract of *Punica granatum*. J Biomed Pharm Res 2016;4:53-61.
11. Leonti M, Casu L. Traditional medicines and globalization: Current and future perspectives in ethnopharmacology. Front Pharmacol 2013;4:92.
12. Yuan H, Ma Q, Ye L, Piao G. The traditional medicine and modern medicine from natural products. Molecules 2016;21:559.
13. Taqui R, Debnath M, Ahmed S, Ghosh A. Advances on plant extracts and phytocompounds with acetylcholinesterase inhibition activity for possible treatment of Alzheimer's disease. Phytomed Plus 2022;2:100184.
14. Baldé MA. Phytochemical, Antimicrobial and Antiplasmodial Investigations on Guinean Plant Species [Doctoral Dissertation, University of Antwerp]; 2021.
15. Abajue MC, Sawyer WE, Izah SC, Ogwu MC. Diversity of medicinal plants used in the treatment and management of viral diseases transmitted by mosquitoes in the tropics. In: Herbal Medicine Phytochemistry: Applications and Trends. Cham: Springer International Publishing; 2024. p. 383-416.
16. Jordan SA, Cunningham DG, Marles RJ. Assessment of herbal medicinal products: Challenges, and opportunities to increase the knowledge base for safety assessment. Toxicol Appl Pharmacol 2010;243:198-216.
17. Sharifi-Rad J, Rayess YE, Rizk AA, Sadaka C, Zgheib R, Zam W, *et al*. Turmeric and its major compound curcumin on health: Bioactive effects and safety profiles for food, pharmaceutical, biotechnological and medicinal applications. Front Pharmacol 2020;11:01021.
18. Sharma R, Bhattu M, Tripathi A, Verma M, Acevedo R, Kumar P, *et al*. Potential medicinal plants to combat viral infections: A way forward to environmental biotechnology. Environ Res 2023;227:115725.
19. Lim SY, Chieng JY, Pan Y. Recent insights on anti-dengue virus (DENV) medicinal plants: Review on *in vitro*, *in vivo* and *in silico* discoveries. All Life 2021;14:1-33.
20. Karuppusamy S. Vegetation and forest types of the western ghats. In: Biodiversity Hotspot of the Western Ghats and Sri Lanka. Canada: Apple Academic Press; 2024. p. 25-61.
21. Parthasarathy N, Karthikeyan R. Plant biodiversity inventory and conservation of two tropical dry evergreen forests on the Coromandel coast, South India. Biodivers Conserv 1997;6:1063-83.
22. Ngumbau VM, Luke Q, Nyange M, Wanga VO,

Watuma BM, Mbuni YM, *et al*. An annotated checklist of the coastal forests of Kenya, East Africa. PhytoKeys 2020;147:1-191.
23. Al-Madhagy SA, El-Hawary SS, Sabry OM, Gad SS, Mostafa ES. Therapeutic potential of *Pavetta L*. Genus: An updated review of its traditional uses, phytochemistry, pharmacology and toxicological aspects. Egypt J Chem 2022;65:1023-43.
24. Nigussie D, Davey G, Tufa TB, Brewster M, Legesse BA, Fekadu A, *et al*. Antibacterial and antifungal activities of Ethiopian medicinal plants: A systematic review. Front Pharmacol 2021;12:633921.
25. Ab Ghani N, Salleh WM, Salihu AS, Mahsop HS, Abed SA. Characterization of phenolic compounds from *Pavetta graciliflora* Wall. Ex Ridl. (Rubiaceae) and their lipoxygenase inhibitory activity. Malays J Chem 2024;26:217-23.
26. Sychrová A, Kolářiková I, Žemlička M, Šmejkal K. Natural compounds with dual antimicrobial and anti-inflammatory effects. Phytochem Rev 2020;19:1471-502.
27. Mucha P, Skoczyńska A, Małecka M, Hikisz P, Budzisz E. Overview of the antioxidant and anti-inflammatory activities of selected plant compounds and their metal ions complexes. Molecules 2021;26:4886.
28. Rudrapal M, Khairnar SJ, Khan J, Dukhyil AB, Ansari MA, Alomary MN, *et al*. Dietary polyphenols and their role in oxidative stress-induced human diseases: Insights into protective effects, antioxidant potentials and mechanism(s) of action. Front Pharmacol 2022;13:806470.
29. Pistritto G, Trisciuoglio D, Ceci C, Garufi A, D'Orazi G. Apoptosis as anticancer mechanism: Function and dysfunction of its modulators and targeted therapeutic strategies. Aging (Albany NY) 2016;8:603-19.
30. Bose S, Banerjee S, Mondal A, Chakraborty U, Pumarol J, Croley CR, *et al*. Targeting the JAK/STAT signaling pathway using phytocompounds for cancer prevention and therapy. Cells 2020;9:1451.
31. Dubey AR, Prasad A, Poluri KM, Kumar A, Kumar A, Mishra A. Proteome linked biochemical targets: Can repair defective cellular physiological mechanisms? Cell Physiol Biochem 2021;55:49-70.
32. Chandrasekara A, Shahidi F. Inhibitory activities of soluble and bound millet seed phenolics on free radicals and reactive oxygen species. J Agric Food Chem 2011;59:428-36.
33. Ola MS, Nawaz M, Ahsan H. Role of Bcl-2 family proteins and caspases in the regulation of apoptosis. Mol Cell Biochem 2011;351:41-58.
34. Rahmatullah M, Mollik MA, Islam MK, Islam MR, Jahan FI, Khatun Z, *et al*. A survey of medicinal and functional food plants used by the folk medicinal practitioners of three villages in Sreepur Upazilla, Magura district, Bangladesh. Am Euras J Sustain Agric 2010;4:363-73.
35. Steinmeyer J. Pharmacological basis for the therapy of pain and inflammation with nonsteroidal anti-inflammatory drugs. Arthritis Res 2000;2:379-85.
36. Tasneem S, Liu B, Li B, Choudhary MI, Wang W. Molecular pharmacology of inflammation: Medicinal plants as anti-inflammatory agents. Pharmacol Res 2019;139:126-40.
37. Jamshidi-Kia F, Wibowo JP, Elachouri M, Masumi R, Salehifard-Jouneghani A, Abolhassanzadeh Z, *et al*. Battle between plants as antioxidants with free radicals in human body. J Herbmed Pharmacol 2020;9:191-9.
38. Hajipour MJ, Fromm KM, Ashkarran AA, Jimenez De Aberasturi D, De Larramendi IR, Rojo T, *et al*. Antibacterial properties of nanoparticles. Trends Biotechnol 2012;30:499-511.
39. Soetan KO, Oyewole OE. The need for adequate processing to reduce the anti-nutritional factors in plants used as human foods and animal feeds: A review. Afr J Food Sci 2009;3:223-32.
40. Eviner VT, Garbach K, Baty JH, Hoskinson SA. Measuring the effects of invasive plants on ecosystem services: Challenges and prospects. Invasive Plant Sci Manage 2012;5:125-36.
41. Versluis A, Knulst AC, Kruizinga AG, Michelsen A, Houben GF, Baumert JL, *et al*. Frequency, severity and causes of unexpected allergic reactions to food: A systematic literature review. Clin Exp Allergy 2015;45:347-67.

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